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| **US Radiocommunication Sector**  **FACT SHEET** | |
| **Working Party:** ITU-R WP 5B | **Document No:** USWP5B-26/7 |
| **Reference:** 5B/225 Annex 36 | **Date:** 1 February 2021 |
| **Document Title:** Working Document Towards a Preliminary Draft Revision of Recommendation ITU-R M.2116-0, “**Technical characteristics and protection criteria for the aeronautical mobile service systems operating within the 4 400-4 990 MHz frequency range”** | |
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| **Purpose/Objective:** The purpose of this document is to propose a revision to Recommendation ITU-R M.2116-0 | |
| **Abstract:** Recommendation ITU-R M.2116-0 contains characteristics for the aeronautical mobile service systems operating within the 4400-4990 MHz frequency range. The US proposed a revision to Rec. M.2116 to add systems that adds an additional annex to this report to cover maritime systems operating in the frequency band. This contribution seeks to update the proposed new Annex 2 based upon feedback from the last meeting. This contribution will also propose a formal revision to Rec. M.2116 as it was not agreed to be revised at the last meeting (it was attached to the chairman’s report as a working document towards an annex to a reply liaison to WP 5D). | |
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| **Radiocommunication Study Groups** |  |
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| **English only** |
| **United States of America, France, [Australia, Korea (Republic of), etc.]** | |
| PRoposed Working document for a Preliminary draft revision to Recommendation itu-r M.2116-0 | |
| **Technical characteristics and protection criteria for the aeronautical mobile service systems operating within the 4 400-4 990 MHz frequency range** | |

**1 Introduction**

At the twenty-fifth meeting of Working Party 5B (e-meeting, November 2020) several administrations proposed to revise ITU-R *Recommendation ITU-R M.2116-0*. The meeting could not come to agreement about whether to initiate a revision but did agree to carry the input documents forward and discuss further at the next meeting. This contribution acknowledges this agreement and seeks to initiate a revision to ITU-R *Recommendation ITU-R M.2116-0*. Using document 5B/177 as the foundation, the signing administrations propose edits to this Recommendation based upon carried forward documents 5B/63, 5B/163, and 5B/207.

**2 Proposal**

The signing administrations propose that WP 5B consider the attached proposed working document for a preliminary draft new revision *of Recommendation ITU-R M.2116-0*. This revision proposes to add maritime systems characteristics in a separate Annex.

**Attachment:** 1

ATTACHMENT

WORKING DOCUMENT TOWARDS A PRELIMINARY DRAFT REVISION TO RECOMMENDATION ITU-R M.2116-0

**Technical characteristics and protection criteria for the aeronautical and maritime mobile service systems operating within the 4 400-4 990 MHz frequency range**

(20xx)

**Scope**

This Recommendation provides information on the technical characteristics and protection criteria for systems operating in the aeronautical mobile service (AMS) and maritime mobile service (MMS) planned to or currently operating within the frequency range 4 400-4 990 MHz for use in sharing and compatibility studies as needed and does not contain any aeronautical mobile telemetry system.

**Keywords**

Aeronautical mobile service, maritime mobile service, technical characteristics, protection criteria

**Abbreviations/Glossary**

ADL Aeronautical mobile service data link

AMS Aeronautical mobile service

MDL Maritime mobile service data link

MMS Maritime mobile service

**Related ITU-R Recommendations and Reports**

Recommendation ITU-R M.1851 – Mathematical models for radiodetermination radar systems antenna patterns for use in interference analyses

The ITU Radiocommunication Assembly,

*considering*

*a)* that systems and networks operating in the aeronautical mobile service (AMS) and in the maritime mobile service (MMS) are used in national as well as international airspace, in accordance with the radio regulations, for broadband, data-links including aircraft to aircraft links, to support carious applications such as remote sensing, e.g. earth sciences, land management, energy distribution, etc., ;

*b)* that systems and networks operating in AMS and MMS are also used for narrow-band, airborne data-links;

*c)* that systems and networks operating in the maritime mobile service (MMS) are used in national and international waters, in accordance with the radio regulations, for broadband, maritime data-links including ship to aircraft links, to support various applications as remote sensing, e.g. earth sciences, land management, energy distribution, etc;

*d)* that the physics of the propagation of electromagnetic energy, the availability of hardware components, etc., within the 4 400‑4 990 MHz frequency range facilitates the use of current or planned operating systems and networks for such applications,

*recognizing*

*a)* that the frequency range 4 400-4 990 MHz is allocated on a primary basis in all three ITU regions to the mobile service;

*b)* that other radio services are allocated on either a primary or secondary basis in all or parts of the frequency range 4 400-4 990 MHz all three ITU regions;

*c)* that the RR No. **5.442** provides some restrictions for the use of AMS in parts of the frequency band;

*d)* that technical characteristics and protection criteria for aeronautical mobile telemetry and maritime mobile telemetry systems are not contained in this Recommendation,

*recommends*

1. **1** that the technical characteristics and protection criteria for systems operating in the AMS given in the Annex 1 should be used in performing sharing and compatibility analyses.

**2** that the technical characteristics and protection criteria for systems operating in the MMS given in Annex 2 should be used in performing sharing and compatibility analyses.

**3** that the following Note is considered as part of this Recommendation.

NOTE – The characteristics and protection criteria should not have any adverse effect to Appendix **30B** of the Radio Regulations

**Annex 1  
  
Technical characteristics and protection criteria for aeronautical mobile systems**

**1 Introduction**

Systems and networks operating in the AMS are used for broadband, airborne data-links including aircraft to aircraft, to support various applications as remote sensing, e.g. earth sciences, land management, energy distribution, etc..

**2 Operational deployment**

Aeronautical mobile data links are operated between aeronautical stations and aircraft stations, or between aircraft stations or ship stations equipped with AMS data links (ADL) and can be deployed anywhere except within countries whose administration has not authorized their use.

ADL includes transmission from and to, either aircraft stations or a ground terminal considered as an aeronautical station. These transmissions could use bidirectional air‑to‑ground links, or relay through another airborne platform using an air‑to‑air data link. Links can be either simplex or duplex. The link lengths vary greatly in these applications. Although some of the link lengths may be relatively short, many of the link lengths approach the radio line‑of‑sight distance. The operational altitude of airborne platforms equipped with these ADLs can vary from ground/sea level to up to 20 000 m.

The ground terminals may be at a permanent location or they may be transportable. Transportable ground terminals can be moved to meet operational needs and the duration of use while it remains at a particular location is dependent upon operational requirements. Transportable ground terminals may be installed on ships.

A single ground terminal may simultaneously support several aircraft stations at the same time via different links.

[Author’s note: Proposed text is from source 5B/163]

The application of proposed system is an automated unmanned aerial vehicle (UAV) based wide area ocean surface exploration system used to conduct multiple activities including maritime search and rescue, disaster relief support activities and support to air crash investigations conducted in territorial and international waters. The system consists of multiple UAVs conducting video surveillance of a wide ocean surface area. In order to achieve the required coverage that satisfies large video surveillance footprints, the UAVs form a mesh network to deliver high resolution video to either a ship or land based command and monitoring centers. The received video data is used to identify objects of interest, such as, aircraft debris and distressed personnel. The frequency selection for individual UAVs depends on the number of UAVs participating in a task and their bandwidth requirements. The mesh network can be configured in multiple ways depending on the task requirements, either as a single network or multiple sub-networks assigned with dedicated frequency channels and bandwidths. Following figure depicts the above mentioned application. Table 1 contains the characteristics of the radio frequency (RF) systems used for payload communications. It should be noted that Table 1 only depicts RF systems used for payload communications as part of this application and those used for non-payload communications are not indicated in this table. In Table 1, Airborne 1 and Airborne 2 represent two UAVs with similar RF system characteristics and are used to identify two ends of a single hop communication link within the mesh network.

Figure 1

**Operation of UAV based wide area ocean surface exploration system**



**3 Technical characteristics of aeronautical mobile systems**

Typical technical characteristics for representative airborne data links for the frequency range 4 400-4 990 MHz are provided in Table 1.

**3.1 Transmitter and receiver characteristics**

The aeronautical mobile systems operating or planned to operate within the frequency range 4 400‑4 990 MHz typically use digital modulations. A given transmitter may be capable of radiating more than one waveform.

**3.2 Antenna characteristics**

A variety of different types of antennas are used by systems in the frequency range 4 400‑4 990 MHz. Antennas in this range are generally of a variety of sizes and vary between the airborne component of the link and the ground based component of the link. The airborne antenna gains are typically between +3 dBi and 19 dBi. The ground based antenna gain is typically between 3 dBi and 31 dBi. Horizontal, and vertical polarizations could be used.

Antenna characteristics available in Table 1 should be used for studies unless measured data is available.

**4 Protection criteria**

An increase in receiver effective noise of 1 dB would result in significant degradation in communication range.

Such an increase in effective receiver noise level corresponds to an (*I* + *N*)/*N* ratio of 1.26, or an *I/N* ratio of about −6 dB. This represents the required protection criterion for the AMS systems referenced herein from interference due to another radiocommunication service. If multiple potential interference sources are present, protection of the AMS and MMS systems requires that this criterion is not exceeded due to the aggregate interference from the multiple sources.

TABLE 1

[ams SYSTEMS FROM CONTRIBUTION 5b/67 (ROK), 5b/163 (AUS), 5b/207 (F) TO BE INCLUDED FOR THE MULTI-COUNTRY PROPOSAL]

**Typical technical characteristics of representative aeronautical mobile service systems operated in the frequency range 4 400-4 990 MHz**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Units** | **System 1**  **Airborne** | **System 1**  **Ground** | | | **System 2**  **Airborne** | **System 2**  **Ground** | | |
| Transmitter | | | | | | | | | |
| Tuning range | MHz | 4 400-4 990(1) | 4 400-4 990(1) | | | 4 400-4 990(1) | 4 400-4 990(1) | | |
| Power output | dBm | 45 | 45 | | | 35-39 | 30-39 | | |
| Bandwidth (3 dB) | MHz | 1 | 1 | | | 6 / 10 / 20 | 6 / 10 / 20 | | |
| **Receiver** | | | | | | | | | |
| Tuning range | MHz | 4 400-4 990(1) | 4 400-4 990(1) | | | 4 400-4 990(1) | 4 400-4 990(1) | | |
| Selectivity (3 dB) | MHz | 1 | 1 | | | 6 / 10 / 20 | 6 / 10 / 20 | | |
| Noise figure | dB | 3.5 | 3 | | | 3.5 | 3 | | |
| Thermal noise level | dBm | −110.5 | −111 | | | −102.5 to −97.5 | −103 to −98 | | |
| **Antenna** | | | | | | | | | |
| Antenna type |  | Omnidirectional | Omni-directional | Directional | | Omnidirectional | Omni-directional | Directional | |
| Antenna gain | dBi | 3 | 3 | 19 | 31 | 3 | 6 | 19 | 31 |
| 1st sidelobe | dBi | N/A(2) | N/A(2) | 6 | 11 | N/A(2) | N/A(2) | 6 | 11 |
| Polarization |  | Vertical | Vertical | Vertical | | Vertical | Vertical | Vertical | |
| Antenna pattern |  | N/A(2) | N/A(2) | Uniform distribution(3) | | N/A(2) | N/A(2) | Uniform distribution(3) | |
| Horizontal beamwidth | Degrees | 360 | 360 | 16 | 3.3 | 360 | 360 | 16 | 3.3 |
| Vertical beamwidth | Degrees | 90 | 90 | 16 | 3.3 | 90 | 90 | 16 | 3.3 |

TABLE 1 (*Continued*)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Units** | **System 3**  **Airborne** | | **System 3**  **Ground and shipborne**  **(Source: 5B/207)** | | **System 4**  **Airborne** | | **System 4**  **Ground** | |
| Transmitter | | | | | | | | | |
| Tuning range | MHz | 4 400-4 940(1) | | 4 400-4 940(1) | | 4 400-4 940(1) | | 4 400-4 940(1) | |
| Power output | dBm | 42-50 | | 42 | | 43 | | 37 | |
| Bandwidth (3 dB) | MHz | 0.158 / 0.97 / 1.23 / 4.0 | | 0.158 / 0.97 / 1.23 / 4.0 | | 0.158 / 2.4 / 4.8 / 9.6 | | 0.158 / 2.4 / 4.8 / 9.6 | |
| **Receiver** | | | | | | | | | |
| Tuning range | MHz | 4 400-4 940(1) | | 4 400-4 940(1) | | 4 400-4 940(1) | | 4 400-4 940(1) | |
| Selectivity (3 dB) | MHz | 0.2 / 1 / 1.5 / 4.5 | | 0.2 / 1 / 1.5 / 4.5 | | 0.2 / 2.6 / 5.0 / 10 | | 0.2 / 2.6 / 5.0 / 10 | |
| Noise figure | dB | 2.5 | | 2.5 | | 2.5 | | 3 | |
| Thermal noise level | dBm | −118.5 to −105.0 | | −118.5 to −105.0 | | −118.5 to −101.5 | | −118 to −101 | |
| **Antenna** | | | | | | | | | |
| Antenna type |  | Omni-directional | Directional | Omni-directional | Directional | Omni-directional | Directional | Omni-directional | Directional |
| Antenna gain | dBi | 3.5 | 16 | 3 | 30 | 4.5 | 16 | 4 | 30 |
| 1st sidelobe | dBi | N/A(2) | 9 | N/A(2) | 17 | N/A(2) | 9 | N/A(2) | 17 |
| Polarization |  | Vertical | Vertical | Vertical | Vertical | Vertical | Vertical | Vertical | Vertical |
| Antenna pattern |  | N/A(2) | Uniform distribution(3) | N/A(2) | Uniform distribution(3) | N/A(2) | Uniform distribution(3) | N/A(2) | Uniform distribution(3) |
| Horizontal beamwidth | degrees | 360 | 33 | 360 | 4.4 | 360 | 33 | 360 | 4.4 |
| Vertical beamwidth | degrees | 35 | 33 | 40 | 4.4 | 35 | 33 | 60 | 4.4 |

TABLE 1 (*Continued*)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Units** | **System 5**  **Airborne** | | **System 5**  **Ground and shipborne**  **(Source: 5B/207)** | | | **System 6**  **Airborne 1**  **(Source: 5B/63)** | **System 6**  **Airborne 2**  **(Source: 5B/63)** |
| Transmitter | | | | | | | | |
| Tuning range | MHz | 4 400-4 990(1) | | 4 400-4 990(1) | | | 4 400-4 990 | 4 400-4 990 |
| Power output | dBm | 45 | | 45 | | | 30-43 | 30-43 |
| Bandwidth (3 dB) | MHz | 0.4 / 3 / 8.5 | | 0.4 / 3 / 8.5 | | | 5 | 0.008 |
| **Receiver** | | | | | | | | |
| Tuning range | MHz | 4 400-4 990(1) | | 4 400-4 990(1) | | | 4 400-4 990 | 4 400-4 990 |
| Selectivity (3 dB) | MHz | 0.4 / 3 / 17 | | 0.4 / 3 / 17 | | | 0.008 | 5 |
| Noise figure | dB | 3.5 | | 3.5 | | | 4 | 4 |
| Thermal noise level | dBm | −118.5 to −105.0 | | −118.5 to −105.0 | | | -131 | -103.0 |
| **Antenna** | | | | | | | | |
| Antenna type |  | Omni-directional | Directional | Omni-directional | Directional | | Directional | Directional |
| Antenna gain | dBi | 3 | 19 | 3 | 19 | 31 | 14 | 14 |
| 1st sidelobe | dBi | N/A(2) | 6 | N/A(2) | 6 | 11 | -1 | -1 |
| Polarization |  | Vertical | Vertical | Vertical | Vertical | | Vertical | Vertical |
| Antenna pattern |  | N/A(2) | Note X | N/A(2) | Note X | | Uniform distribution  (Refer to Rec. ITU-R M.1851) | Uniform distribution  (Refer to Rec. ITU-R M.1851) |
| Horizontal beamwidth | degrees | 360 | 16 | 360 | 16 | 3.3 | 24 | 28 |
| Vertical beamwidth | degrees | 90 | 16 | 360 | 16 | 3.3 | 24 | 28 |
| Notes:  (1) RR No. **5.442** applies.  (2) N/A – Not applicable.  (3) Refer to Recommendation ITU-R M.1851.  In the Table “-“ means range of values, and “/” means discrete values.  Note X: and otherwise. Here, (x in radians) and .  In the Table “-“ means range of values, and “/” means discrete values. | | | | | | |  |  |

TABLE 1 (*End*)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Units | System 7  Airborne 1  (Source: 5B/163) | System 7  Airborne 2  (Source: 5B/163) | System 7  Ship borne  (Source: 5B/163) | | System 7  Ground  (Source: 5B/163) | |
| Transmitter | | | | | | | |
| Tuning range | MHz | 4 800-4 990 | 4 800-4 990 | 4 800-4 990 | | 4 800-4 990 | |
| Power output | dBm | 27-33 | 27-33 | 35 | | 35 | |
| Bandwidth (3 dB) | MHz | 5/10/20/40 (software configurable) | 5/10/20/40 (software configurable) | 5/10/20/40 (software configurable) | | 5/10/20/40 (software configurable) | |
| Receiver | | | | | | | |
| Tuning range | MHz | 4 800-4 990 | 4800-4 990 | 4 800-4 990 | | 4 800-4 990 | |
| Selectivity (3 dB) | MHz | 5/10/20/40 | 5/10/20/40 | 5/10/20/40 | | 5/10/20/40 | |
| Noise figure | dB | 6 | 6 | 4 | | 4 | |
| Thermal noise level | dBm | −101 to -92 | −101 to -92 | −103 to −94 | | −103 to −94 | |
| Antenna | | | | | | | |
| Antenna type |  | Omnidirectional | Omnidirectional | Omni-directional | Directional | Omni-directional | Directional |
| Antenna gain | dBi | 4.7 | 4.7 | 6 | 11.8 | 6 | 11.8 |
| 1st sidelobe | dBi | N/A | N/A | N/A | Note 2 | N/A | Note 2 |
| Polarization |  | Vertical | Vertical | Vertical | Vertical | Vertical | Vertical |
| Antenna pattern |  | N/A | N/A | Note 1 | Note 2 | Note 1 | Note 2 |
| Horizontal beamwidth | Degrees | 360 | 360 | 360 | 30 | 360 | 30 |
| Vertical beamwidth | Degrees | 90 | 90 | 28 | 18 | 28 | 18 |

Note 1: Recommendation ITU-R F.1336-5, section 2.2

Note 2: Recommendation ITU-R F.1336-5, section 3.1

**Annex 2  
  
Technical characteristics and protection criteria for maritime mobile systems**

**1 Introduction**

[TBD]

**2 Operational deployment**

The maritime mobile system listed in Table 2 uses maritime mobile service data links (MDL) to create a mesh network radio system between ship stations and ground stations to transfer data between nodes. These transmissions could include ship-to-ship, ship-to-coast, or coast-to-ship datalinks. This system can be deployed near a coast or out in international waters.

The usage of this system supports several operations, such as maritime search and rescue, disaster relief, and surveillance. These radio systems are installed on ship stations and ground stations along the coast to allow for datalinks required to transfer data such as imaging and video amongst the users of this mesh network. The mesh network allows for the ships to communicate with other vessels both near port and out in open waters with enough bandwidth capacity to facilitate multiple users over large areas. The links utilized are expected to only extend to radio-line of sight, however there may be multiple nodes in the mesh network and the deployment is expected to occupy an area far larger than any one individual desired link.

**3 Technical characteristics of maritime mobile systems**

Typical technical characteristics for representative maritime data links for the frequency range 4 400-4 990 MHz are provided in Table 2.

**3.1 Transmitter and receiver characteristics**

The maritime mobile systems operating or planned to operate within the frequency range 4 400‑4 990 MHz typically use digital modulations. A given transmitter may be capable of radiating more than one waveform.

**3.2 Antenna characteristics**

The maritime mobile system listed in Table 2 may use various types of omnidirectional antennas that can be installed on either the ship station or ground station. These omnidirectional antenna gains are typically between 2.5 and 6 dBi.

**4 Protection criteria**

An increase in receiver effective noise of 1 dB would result in significant degradation in communication range.

Such an increase in effective receiver noise level corresponds to an (*I* + *N*)/*N* ratio of 1.26, or an *I/N* ratio of about −6 dB. This represents the required protection criterion for the MMS systems referenced herein from interference due to another radiocommunication service. If multiple potential interference sources are present, protection of the MMS systems requires that this criterion is not exceeded due to the aggregate interference from the multiple sources.

TABLE 2

**Typical technical characteristics of representative maritime mobile service systems operated in the frequency range 4 400-4 990 MHz**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Units** | **System 1**  **Ship** | | | **System 1**  **Ground** | | |
| Transmitter | | | | | | | |
| Tuning range | MHz | 4 400-4 940 | | | 4 400-4 940 | | |
| Power output | dBm | 39 | | | 39 | | |
| Bandwidth (3 dB) | MHz | 5.6/11.3/22.6 | | | 5.6/11.3/22.6 | | |
| Receiver | | | | | | | |
| Tuning range | MHz | 4 400-4 940 | | | 4 400-4 940 | | |
| Selectivity (3 dB) | MHz | 5.6/11.3/22.6 | | | 5.6/11.3/22.6 | | |
| Noise figure | dB | 6 | | | 6 | | |
| Thermal noise level | dBm | -101 to -93 | | | -101 to -93 | | |
| Antenna | | | | | | | |
| Antenna type |  | Omnidirectional | | | Omni-directional | | |
| Antenna gain | dBi | 6 | 4.2 | 2.5 | 6 | 4.2 | 2.5 |
| 1st sidelobe | dBi | N/A(1) | | | N/A(1) | | |
| Polarization |  | Vertical | | | Vertical | | |
| Antenna pattern |  | N/A(1) | | | N/A(1) | | |
| Horizontal beamwidth | Degrees | 360 | | | 360 | | |
| Vertical beamwidth | Degrees | 30 | 37 | 69 | 30 | 37 | 69 |
| Notes:  (1) N/A – Not applicable. | | | | | | | |

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